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PSEG
Nuclear L.L.C.
10CFR50.55a

LR-N09-0018
March 23, 2009

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

HOPE CREEK GENERATING STATION
FACILITY OPERATING LICENSE NO. NPF-57
DOCKET NO. 50-354

SUBJECT: RELIEF REQUEST RR-HC-I3R-04
PROPOSED ALTERNATE REPAIR METHOD

In accordance with 10 CFR 50.55a, Codes and Standards, paragraph (a)(3)(i), PSEG Nuclear LLC (PSEG Nuclear) is submitting a proposed alternative to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components". The proposed alternative requirements described in the attachments would permit the use of a full structural weld overlay repair for weld indications that may be identified in reactor vessel safe-end to nozzle weld joints during the upcoming Hope Creek RF15 Refueling Outage (RF15). RF15 is scheduled to begin on April 10, 2009 and continue for twenty-three days.

The Hope Creek Unit 1 Third Ten-Year Interval In-Service Inspection (ISI) Program complies with the requirements of the ASME Code Section XI, 2001 Edition 2003 Addenda. The Hope Creek Third 10-year Interval began on December 13, 2007 and is projected to end December 12, 2017.

PSEG Nuclear is seeking a normal review period for this request; however, based on the outage inspection findings, PSEG Nuclear may seek to accelerate the NRC review. If repairs are deemed to be necessary and the repair is bounded by this proposed alternate repair method, PSEG Nuclear would request approval prior to the completion of RF15, namely on or about April 30, 2009. There are no Regulatory Commitments contained in this letter.

If you have any questions or require additional information, please contact Mr. Philip J. Duca at (856) 339-1640.

Sincerely

Jeffrie J. Keenan
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Attachment 1 – Overview
Attachment 2 – Relief Request RR-HC-I3R-04

A047
NRR

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Overview of Alternative Repair for the
Hope Creek Reactor Vessel Nozzle Welds During RF15

Introduction

PSEG Nuclear LLC (PSEG Nuclear), requests relief from certain American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) requirements at Hope Creek Nuclear Station. As part of Hope Creek's Refueling Outage (RF15) dissimilar metal joints are receiving an unscheduled ASME Section XI inspection in response to BWRVIP 2008-293. As an alternative to the ASME Code requirements, PSEG Nuclear proposes to implement weld overlay repairs (if required) in accordance with ASME Code Cases N-638-1, "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique, Section XI, Division 1" and N-504-3, "Alternative Rules for Repair of Classes 1, 2, and 3 Austenitic Stainless Steel Piping, Section XI, Division 1", as modified by the attached request for relief. This request for relief is based upon restoring the structural integrity of the applicable dissimilar metal welds by applying a full structural weld overlay over the weld joint. The need to perform weld overlay repairs is contingent upon the results of examinations during Refueling Outage (RF15), which is scheduled April 2009.

These welds are contained within the Intergranular Stress Corrosion Cracking (IGSCC) augmented examination program as Category C welds. Accordingly, this re-examination is being performed in accordance with the requirements of BWRVIP 2008-293. The welds will be examined with an ASME Section XI, Appendix VIII, Supplement 10 qualified procedure. Planned inspections will use automated ultrasonic (UT) Phased Array (PA) technique in the axial and circumferential directions.

PSEG Nuclear will employ weld overlay repairs using machine gas tungsten arc welding (GTAW) and Alloy 52M weld metal. Weld overlay repairs have been used in the Boiling Water Reactor (BWR) industry since the 1980s to repair flaws due to IGSCC, including safe end-to-nozzle welds. The experience with weld overlays in the BWR industry has been excellent. Weld overlays have been approved as an effective IGSCC mitigating technique in USNRC Generic Letter 88-01/ NUREG-0313, Rev. 2.

Degradation Mechanism

Experience at similar joints on recirculation inlet nozzle (N2K) at Hope Creek in 2004, recirculation safe end-to-nozzle (N2A) at Hope Creek in 2007 and at other BWRs in the last few years identified the apparent cause of such flaws were due to IGSCC.

Relevant Construction Codes

The Construction Code for the reactor vessel is ASME Section III, 1968 Edition, including Addenda through Summer 1970, except for Paragraph NB-3338.2(d)(4) of the Winter 1971 Addenda.

The original Construction Code for the piping system is ASME Section III, 1974 Edition, including Addenda through Summer 1976. These nozzle welds underwent Mechanical Stress Improvement Process (MSIP) treatment.

IGSCC Weld Overlay Repairs

PSEG Nuclear proposes to conduct weld overlay repairs using machine GTAW and Alloy 52M weld metal. Weld overlay repairs have been used in the BWR industry since the 1980s to repair flaws due to IGSCC. The experience with weld overlays in the BWR industry has been excellent. It is approved as an effective IGSCC repair technique in USNRC Generic Letter 88-01/ NUREG-0313, Rev. 2.

Although MSIP was performed, as a further preventative measure, implementation of an overlay at the nozzle welds will provide further mitigation as discussed below:

1. The overlay is designed as a standard (full structural) overlay per the structural requirements in ASME Code Case N-504-3 and Nonmandatory Appendix Q using paragraph IWB-3640 of ASME Section XI. In the design of a standard overlay, a 360 degree "through the thickness" circumferential flaw is assumed and, therefore, no credit is taken for any portion of the original pipe wall. Hence, all the weld material, where flaw initiation is believed to have occurred, is essentially assumed to be completely flawed. The full ASME Section XI safety margins are restored after the application of a standard overlay.

2. The application of the overlay results in a favorable residual stress field on the inside of the component, which arrests further flaw growth. This is because the overlay establishes compressive residual stresses which prevent further IGSCC initiation and growth.

3. The nickel based Alloy 52M weld wire (ASME Section II, Part C, SFA-5.14, ERNiCrFe-7A, UNS N06054), which is used for the GTAW overlay repairs, has been shown to be highly resistant to IGSCC. This alloy, containing nominally 30 wt. % chromium, and its corresponding wrought material, Alloy 690, have been demonstrated in laboratory testing, in modeling studies, and in the field, to be highly resistant to IGSCC initiation and growth in the BWR environment.

Examinations

Subsequent examinations of the overlay will be performed in accordance with the requirements of Section XI and IGSCC Program.

Similar Plant Experience

The requested alternatives for the repairs at Hope Creek Unit 1 are consistent with the documented safety evaluation reports (SERs) previously issued for Hope Creek in 2004 on the recirculation inlet safe end-to-nozzle (N2K) weld (TAC No. MC5173), Recirculation safe end-to-nozzle (N2A) at Hope Creek in 2007, as well as other plants including Duane Arnold (TAC No. MD4466), Susquehanna 1 (TAC No's MC2450, MC2451 and MC2594) and Fitzpatrick.

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Proposed Alternative In Accordance with 50.55a(a)(3)(i)
Alternative Provides Acceptable Level of Quality and Safety

1. ASME Code Components Affected

Code Class:	1
References:	ASME Section XI, 2001 Edition, including and through the 2003 Addenda ASME Section XI, Case N-504-3 ASME Section XI, Case N-638-1 NUREG-0313 Rev 2 Generic Letter 88-01 BWRVIP-75-A BWRVIP2008-293
Examination Category:	R-A (formerly B-F)
Item Number:	R1.14 (formerly B5.10)
Description:	Alternative Repair for Overlays to the following Welds
Component Number:	RPV1-N2BSE (12") Recirculation Inlet Nozzle to Safe End RPV1-N2CSE (12") Recirculation Inlet Nozzle to Safe End RPV1-N2ESE (12") Recirculation Inlet Nozzle to Safe End RPV1-N2FSE (12") Recirculation Inlet Nozzle to Safe End RPV1-N2GSE (12") Recirculation Inlet Nozzle to Safe End RPV1-N2HSE (12") Recirculation Inlet Nozzle to Safe End RPV1-N2JSE (12") Recirculation Inlet Nozzle to Safe End RPV1-N5ASE (10") Core Spray Nozzle to Safe End RPV1-N5Asex (10") Core Spray Safe End to Extension RPV1-N5Bsex (10") Core Spray Safe End to Extension RPV1-N8ASE (4") Jet Pump Instrument Nozzle to Safe End RPV1-N8BSE (4") Jet Pump Instrument Nozzle to Safe End

2. Applicable Code Edition and Addenda

The Hope Creek Unit 1 Third Ten-Year Interval In-service Inspection (ISI) Program complies with the requirements of the ASME Code Section XI, 2001 Edition, including Addenda through 2003. The Third 10-year interval began on December 13, 2007 and is currently projected to end December 12, 2017.

3. Applicable Code Requirements

The following information is from ASME Boiler and Pressure Vessel Code, Section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," 2001 Edition, including Addenda through 2003, which identifies the specific requirements included in this alternative:

IWA-4421(a) and IWA-4611.1(a) require removal of the detected flaw.

IWA-4610(a) requires that the area to be welded shall be preheated to 300°F minimum for gas tungsten arc welding (GTAW).

IWA-4610(a) requires that thermocouples (TCs) shall be used to monitor process temperatures.

IWA-4631(b) specifies that the surface of the completed weld on the ferritic steel shall not exceed 100 square inches.

4. Reason for Request

Pursuant to 10 CFR 50.55a, "Codes and Standards," Paragraph (a) (3), relief is requested from the requirements of ASME Code Section XI requirements. The request is based upon restoring the structural integrity of the applicable dissimilar metal welds by applying a full structural weld overlay over the weld joint using technically sound welding practices and nondestructive examination (NDE), while limiting repair personnel exposure. Currently, there exist no NRC generically approved Code criteria for a licensee to apply a full structural weld overlay at ambient temperature to dissimilar metal welds involving nickel alloys such as Alloy 600, 82 and 182.

The following cited Code articles identify the actions that would be required if the repairs were conducted in accordance with the Code without exception.

IWA-4421(a) and IWA-4611.1(a) require defect removal in this case. The repair cavity would extend through wall since OD removal would be required.

IWA-4610(a) requires the area to be welded shall be preheated to 300°F minimum for GTAW. Some of the nozzles may remain full of water, establishing the 300°F minimum preheat temperature cannot be achieved.

IWA-4610(a) requires the use of TCs to monitor process temperatures. Due to the, nozzle configuration, personnel exposure associated with the installation and removal of the TC's and some of the nozzles filled with water, a calibrated contact pyrometer will be used in lieu of TCs to verify preheat and interpass temperature limits.

IWA-4631(b) specifies "The surface of the completed weld shall not exceed 100 sq. in." Restoring the structural integrity of the weld with a weld overlay may require welding on more than 100 square inches of surface on the low alloy steel base material.

Pursuant to 10 CFR 50.55a (a) (3) (i), an alternative is requested on the basis that the proposed repairs will provide an acceptable level of quality and safety.

5. Proposed Alternative and Basis for Use

The components for which full structural weld overlay repairs may be needed are identified in Table 1.

The weld overlays will be implemented consistent with the requirements of NUREG-0313, Revision 2 (which was implemented by Generic Letter 88-01), Code Case N-504-3, "Alternative Rules for Repair of Classes 1, 2 and 3 Austenitic Stainless Steel Piping," Code Case N-638-1 "Similar and Dissimilar Metal Welding Using Ambient Temperature GTAW Temper Bead Technique" Section XI, Division 1, and IWB-3640, ASME Section XI 2001 Edition, including Addenda through 2003 with Appendix C and Nonmandatory Appendix Q.

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Alternative Provides Acceptable Level of Quality and Safety

Table 1

Component ID	Component Description	Material 1	Material 2	Filler Material	Butter Material
RPV1-N2BSE	12" Recirculation Inlet Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SA182 F316L (SS)	ENiCrFe-3/ ERNiCr-3	ENiCrFe-3
RPV1-N2CSE	12" Recirculation Inlet Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SA182 F316L (SS)	ENiCrFe-3/ ERNiCr-3	ENiCrFe-3
RPV1-N2ESE	12" Recirculation Inlet Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SA182 F316L (SS)	ENiCrFe-3/ ERNiCr-3	ENiCrFe-3
RPV1-N2FSE	12" Recirculation Inlet Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SA182 F316L (SS)	ENiCrFe-3/ ERNiCr-3	ENiCrFe-3
RPV1-N2GSE	12" Recirculation Inlet Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SA182 F316L (SS)	ENiCrFe-3/ ERNiCr-3	ENiCrFe-3
RPV1-N2HSE	12" Recirculation Inlet Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SA182 F316L (SS)	ENiCrFe-3/ ERNiCr-3	ENiCrFe-3
RPV1-N2JSE	12" Recirculation Inlet Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SA182 F316L (SS)	ENiCrFe-3/ ERNiCr-3	ENiCrFe-3
RPV1-N5ASE	10" Core Spray Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SB-166 (Alloy 600)	ENiCrFe-3/ ERNiCr-3/ SB-166 safe-end	ENiCrFe-3
RPV1-N5Asex	10" Core Spray Safe End to Extension	Safe end: SB-166 (Alloy 600)	Safe end extension: SA-508 Class 1	ENiCrFe-3	ENiCrFe-3
RPV1-N5Bsex	10" Core Spray Safe End to Extension	Safe end: SB-166 (Alloy 600)	Safe end extension: SA-508 Class 1	ENiCrFe-3	ENiCrFe-3
RPV1-N8ASE	4" Jet Pump Instrument Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SA-182 F304L	ENiCrFe-3/ ERNiCr-3	ENiCrFe-3
RPV1-N8BSE	4" Jet Pump Instrument Nozzle to Safe End	Nozzle: SA-508 Class 2	Safe end: SA-182 F304L	ENiCrFe-3/ ERNiCr-3	ENiCrFe-3

Welder Qualification and Welding Procedures

Welders and welding operators will be qualified in accordance with ASME Section IX and any special requirements of ASME XI or applicable code cases.

Welding Wire

Machine GTAW with cold wire feed for welding SFA-5.14, ERNiCrFe-7A, UNS N06054, F-No. 43 (commercially known as Alloy 52M) will be used.

This consumable welding wire is highly resistant to IGSCC and has been selected for the overlay material. Alloy 52M contains a nominal 30 wt% Cr that imparts excellent resistance to IGSCC.

Weld Overlay Design

The weld overlay will extend around the full circumference of the weldment locations in accordance with Code Case N-504-3 and Non-mandatory Appendix Q. The overlay length will extend across the projected flaw intersection with the outer surface beyond the extreme axial boundaries of the flaw. The design thickness and length have been computed in accordance with the guidance provided in Code Case N-504-3, Nonmandatory Appendix Q, and Appendix C. The overlay will completely cover the area of the flaw and the Alloy 82 and 182 material with the highly resistant Alloy 52M weld filler material.

To provide the necessary weld overlay geometry, it will be necessary to weld on the low alloy steel nozzle base material. A temperbead welding approach will be used for this purpose following the guidance of ASME Section XI Code Case N-638-1 "Similar and Dissimilar Metal Welding Using Ambient Temperature Machine GTAW Temper Bead Technique", Section XI, Division 1. This Code Case provides for machine GTAW temperbead weld repairs to P-No. 3 Group No. 3 nozzle base materials at ambient temperature. The temperbead approach was selected because temperbead welding supplants the requirement for post weld heat treatment (PWHT) of the heat-affected zone (HAZ) in welds on low alloy steel material. Also, the temperbead welding technique produces excellent toughness and ductility as demonstrated by welding procedure qualification in the HAZ of welds on low alloy

steel materials. This results in compressive residual stresses on the inside piping surface in addition to those imparted by MSIP which assists in inhibiting IGSCC initiation and growth.

Examination Requirements

Table 2 summarizes the examination requirements for the weld overlay repairs.

Code Case N-504-3 and Nonmandatory Appendix Q, specify UT using methods and personnel qualified in accordance with ASME Section XI, Appendix VIII. The UT techniques to be used for the final weld overlay post-weld examination satisfy the requirements of ASME Section XI, Appendix VIII Supplement 11.
The acceptance criteria that will be used for the UT will be ASME Section XI Nonmandatory Appendix Q, Weld Overlay Repair of Class 1, 2, and 3 Austenitic Stainless Steel Piping Weldments and further clarified under the Exceptions to Code Case N-638-1 Paragraph 4.0(b) discussed below.

Pressure Testing

The completed repairs shall be given a system leakage test in accordance with ASME Section XI, IWA-5000.

Preheat and Post Weld Heat Treatment (PWHT) Requirements

Preheat and PWHT are typically required for welding on low alloy steel material. ASME Section III specifies PWHT on P-No. 3 Group No. 3 base materials unless temperbead welding is performed under limited restrictions (area and depth limits). ASME Section XI, 2001 Edition including Addenda through 2003, specifies 300°F minimum preheat be used for temperbead welding. PWHT cannot be performed and the preheat requirements would necessitate draining the reactor vessel (RV). This would create unacceptable levels of airborne contamination. Therefore, consistent with ALARA practices and prudent utilization of outage personnel, the RV will not be drained for this activity.

Alternatives to Code Case N-504-3

Code Case N-504-3 Applicability to Nickel Based Austenitic Steel

Code Case N-504-3 was prepared specifically for austenitic stainless steel material. An alternate application for nickel based austenitic materials (Alloy 52M) is needed due to the specific materials and configuration of the existing nickel based alloy weld and buttering.

Exception to Code Case N-504-3, Requirement (b)

Code Case N-504-3, Requirement (b) requires the weld overlay shall be low carbon (0.035% maximum) austenitic stainless steel. A nickel-based filler Alloy 52M will be used.

A consumable welding wire highly resistant to IGSCC was selected for the overlay material. This material, designated as UNS N06054, F-No. 43, is a nickel based alloy weld filler material, commonly referred to as Alloy 52M and will be deposited using the machine GTAW process with cold wire feed. Alloy 52M contains nominally 30 wt% chromium, which imparts excellent corrosion resistance to the material. By comparison, Alloy 82 is identified as an IGSCC resistant material in NUREG-0313 Revision 2 and contains nominally 20 wt% chromium while Alloy 182 has a nominal chromium content of 15 wt%. With its higher chromium content than Alloy 82/182, Alloy 52M provides an even higher level of resistance to IGSCC consistent with the requirements of the Code Case. Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-504-3, Requirement (e)

Code Case N-504-3, Requirement (e) requires the first two layers of the weld overlay to have a ferrite content of at least 7.5 FN (Ferrite Number). These measurements will not be performed for this overlay since the nickel alloy filler is a fully austenitic material.

The composition of nickel-based Alloy 52M is such that delta ferrite does not form during welding. Delta ferrite measurements will not be performed for this overlay because Alloy 52M welds contain no delta ferrite due to the high nickel composition (nominally 60 wt% nickel).

The weld overlay is deposited using Nickel Alloy 52M filler metal instead of austenitic stainless steel filler metals. The basis for crediting the first layer towards the required design thickness will be based on the chromium content of the nickel alloy filler metal. For BWR applications, a diluted layer may be credited toward the

required thickness provided the portion of the layer over the austenitic base material, and the associated dilution zone from an adjacent ferritic base material contain at least 20% chromium. The chromium content is determined by chemical analysis of the production weld or of a representative coupon taken from a mockup prepared in accordance with the welding procedure specification (WPS) for the production weld.

Structural Integrity Associates report SI-05-030, Rev. 0, "Effect of Chromium Content on Nickel-Base Alloy IGSCC Resistance," is available on the ASME website in support of crediting the first overlay layer toward design thickness for both BWR and PWR applications. The report concludes that a minimum of 20% chromium must be present in the first overlay layer to be considered resistant to IGSCC in the BWR environment.

Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-504-3, Requirement (h)

Code Case N-504-3, Requirement (h) specifies that a system hydrostatic test shall be performed in accordance with IWA-5000 if the flaw penetrates the pressure boundary. A system leakage test in accordance with ASME Section XI, IWA-5000, will be performed in lieu of the system hydrostatic test.

Therefore, this alternative provides an acceptable level of quality and safety.

Alternatives to Code Case N-638-1

Exception to Code Case N-638-1 Paragraph 1.0(a)

Code Case N-638-1 paragraph 1.0(a) specifies that the maximum weld area on the finished surface shall be 100 square inches. Restoring the structural integrity with the weld overlay of the welds identified in Table 1 may require welding on more than 100 square inches of surface on the low alloy steel base material.

EPRI Technical Report 1003616 provides technical justification for exceeding the size of the temperbead repairs up to a finished area of 500 square inches over the ferritic material. The area of the finished overlay over the ferritic material will be substantially less than 500 square inches. The weld overlay will extend over the ferritic material so that qualified UT of the required volume can be performed. There have been a number of temperbead weld overlay repairs applied to welds in the nuclear industry, and weld overlay repairs having a 300 square inches surface area

were recently approved for Susquehanna Steam Electric Station Unit 1 (TAC Nos. MC2450, MC2451 and MC2594), D.C. Cook Unit 1 (TAC No. MD2119) and Fitzpatrick. All nozzle weld overlays will be less than 300 square inches.

Results of industry analyses and testing performed to date have indicated that there is no direct correlation of amount of surface area repaired when comparing residual stresses using temperbead welding. Residual stresses associated with larger area repairs (>100 square inches) remain compressive at an acceptable level. Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-638-1 Paragraph 4.0(b)

Code Case N-638-1 paragraph 4.0(b) specifies that the final weld surface and band area (1.5T width) shall be examined using a surface and ultrasonic methods when the completed weld has been at ambient temperature for at least 48 hours.

The ultrasonic examination shall be in accordance with ASME Section XI Appendix I. Full ultrasonic examination of the 1.5T band will not be performed and the examination will be performed no sooner than 48 hours after completion of the third temperbead layer over the ferritic base material. UT examinations will be performed in accordance with ASME Section XI Appendix VIII Supplement 11.

The required liquid penetrant examination of 4.0 (b) will be performed. In lieu of the ultrasonic examination in accordance with Appendix I, the ultrasonic examination will be in accordance with Code Case N-504-3, and Nonmandatory Appendix Q which states to perform UT examinations in accordance with ASME Section XI Appendix VIII Supplement 11. Examination of the weld overlay covering the ferritic base material shall be performed no sooner than 48 hours after completion of the third temperbead layer over the ferritic base material.

For the application of the weld overlay repairs addressed in this request the appropriate examination methodologies and volumes are provided in Code Case N-504-3 and Nonmandatory Appendix Q. Code Case N-638-1 applies to any type of welding where a technique is to be employed but is not specifically written for weld overlay repairs.

EPRI research (Technical Report 1013558, *Temperbead Welding Applications – 48 Hour Hold Requirement for Ambient Temperature Temperbead Welding*) has shown that it is not necessary to wait until ambient temperature is reached before initiating the 48-hour hold in order to assure adequate hydrogen removal. No further tempering or potential hydrogen absorption effects will occur after deposition of the

third overlay layer. The described approach has previously been reviewed and approved by the NRC (*Safety Evaluation By the Office of Nuclear Reactor Regulation Related To ASME Code, Section XI, Alternatives for Union Electric Company Callaway Plant, Unit 1, Docket No. 50-483, July 10, 2007*). Therefore, this alternative provides an acceptable level of quality and safety.

Exception to Code Case N-638-1 Paragraph 4.0(c)

Code Case N-638-1 paragraph 4.0(c) specifies that the area from which weld-attached thermocouples have been removed shall be ground and examined using a surface examination method. Due to the personnel exposures associated with the installation and removal of the TCs, the nozzle configuration, and since the nozzle will be full of water, TCs will not be used to verify that preheat and interpass temperature limits are met. In lieu of TCs, a calibrated contact pyrometer will be used to verify preheat temperature and interpass temperature compliance with the WPS requirements. Therefore, this alternative provides an acceptable level of quality and safety.

Basis for the Alternative to ASME Section XI

IWA-4421(a) and **IWA-4611.1(a)** require defect removal in this case. The repair cavity would extend through wall since OD removal would be required. The ID on some nozzles is inaccessible due to the thermal sleeve. Therefore the flaw will not be removed. Structural weld overlays covering flaws are permitted by Code Case N-504-3, provided the necessary weld overlay geometry is satisfied. Therefore, this alternative provides an acceptable level of quality and safety.

IWA-4610(a) requires the area to be welded shall be preheated to 300°F minimum for GTAW. Since some nozzles will remain full of water, establishing the 300°F minimum preheat temperature cannot be achieved. Code Case N-638-1, paragraph 1.0(b) provides for machine GTAW temperbead weld repairs to P-No. 3 Group No. 3 nozzle base material at ambient temperature. The ambient temperature temperbead approach was selected because temperbead welding eliminates the requirement for PWHT of the heat-affected zones in welds on low alloy steel material. Also, the temperbead welding technique produces excellent toughness and ductility, as demonstrated by welding procedure qualification, in HAZ of welds on low alloy steel materials. Therefore, this alternative provides an acceptable level of quality and safety.

IWA-4610(a) also requires the use of TCs to monitor process temperatures. Due to the nozzle configuration, personnel exposure associated with the installation and

removal of the TC's, and some of the nozzles being filled with water, a calibrated contact pyrometer will be used in lieu of TCs to verify preheat and interpass temperature limits. In the first three layers, the interpass temperature will be measured every three to five passes. After the first three layers, interpass temperature measurements will be taken every six to ten passes for the subsequent layers. Contact pyrometers will be calibrated in accordance with approved calibration and control program documents. The use of a contact pyrometer provides equivalent temperature monitoring capabilities and is recognized as acceptable calibrated measuring and test equipment (M&TE). Therefore, this alternative provides an acceptable level of quality and safety.

IWA-4631(b) specifies the surface of the completed weld on the ferritic steel shall not exceed 100 square inches. Restoring the structural integrity with a weld overlay may require welding on more than 100 square inches of surface on the low alloy steel base material.

EPRI Technical Report 1003616, "Additional Evaluations to Expand Repair Limits for Pressure Vessels and Nozzles" provides technical justification for exceeding the size of the temperbead repairs up to a finished area of 500 square inches over the ferritic material. The area of the finished overlay over the ferritic material will be substantially less than this. The weld overlay will extend over the ferritic material so that qualified UT of the required volume can be performed. There have been a number of temperbead weld overlay repairs applied to welds in the nuclear industry, and weld overlay repairs having a 300 square inches surface area were recently approved for Susquehanna Steam Electric Station, D.C. Cook and Fitzpatrick.

Results of industry analyses and testing performed to date have indicated that there is no direct correlation of amount of surface area repaired when comparing residual stresses using temperbead welding. Residual stresses associated with larger area repairs (>100 square inches) remain compressive at an acceptable level. Therefore, this alternative provides an acceptable level of quality and safety.

Summary

The use of the 52M overlay filler material provides excellent resistance to IGSCC and develops an effective barrier to flaw growth. Also, temperbead welding techniques produce excellent toughness and ductility in the weld HAZ low alloy steel materials, and in this case result in compressive residual stresses on the inside surface that help to inhibit IGSCC. The design of the overlay for the safe end-to-nozzle weldment uses methods that are standard in the industry. There are no new or different approaches in this overlay design which are considered first of a kind or inconsistent with previous approaches. The overlay will be designed as a full structural overlay in accordance with Code Case N-504-3. The temperbead welding technique that will be implemented in accordance with Code Case N-638-1 will produce a tough, ductile, corrosion-resistant overlay.

Use of Code Cases N-504-3 and N-638-1 has been conditionally accepted in Regulatory Guide 1.147, Revision 15, as providing an acceptable level of quality and safety.

PSEG concludes that the alternative repair approach described above provides an acceptable level of quality and safety to satisfy the requirements of 10CFR50.55a (a) (3) (i).

6. Duration of Proposed Alternative

This alternative repair is requested for the remainder of the plant life.

7. Precedents

The requested alternatives for the repairs at Hope Creek Unit 1 are consistent with the documented safety evaluation reports (SERs) previously issued for Hope Creek in 2004 on the recirculation inlet safe end-to-nozzle (N2K) weld (TAC No. MD7028), Hope Creek in 2004 on the recirculation safe end-to-nozzle (N2A) weld, as well as other plants including Duane Arnold (TAC No. MD4466), Susquehanna 1 (TAC Nos. MC2450, MC2451 and MC2594) and Fitzpatrick.

8. References

- SI-05-030 - Effect of Chromium Content on Nickel-Base Alloy IGSCC Resistance
- EPRI 1003616 - Additional Evaluations to Expand Repair Limits for Pressure Vessels and Nozzles
- EPRI 1013558 - Temperbead Welding Applications – 48 Hour Hold Requirement for Ambient Temperature Temperbead Welding

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Proposed Alternative In Accordance with 50.55a (a) (3) (i)
Alternative Provides Acceptable Level of Quality and Safety

TABLE 2
Examination Requirements

Exam Description	Method	Technique	Reference
As Found Flaw Detection	UT	PDI Qualified Implementing ASME Section XI Appendix VIII Supplement 10	IWB-3514*
Surface Prior to Welding	PT	Color Contrast (Visible) Penetrant	N-504-3(c) Appendix Q*
Final Weld Overlay Surface	PT	Color Contrast (Visible) Penetrant	N-504-3(j) Appendix Q*
Final Weld Overlay for Thickness (as-built dimensional verification)	Manual Mechanical	Pre and post overlay outside diameter and profile measurement	Appendix Q*
Final Weld Overlay and Outer 25% of the Underlying Wall Thickness Volumetric Pre-service	Manual UT	PDI Qualified Implementing ASME Section XI Appendix VIII Supplement 11	Appendix Q*

* Acceptance Criteria